PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2002-171606
(43)Date of publication of application : 14.06.2002

(51)Int.Cl. B60L 11/14
H01M 10/44
H02J 7/00

(21)Application number : 2000-361636
(22)Date of filing : 28.11.2000

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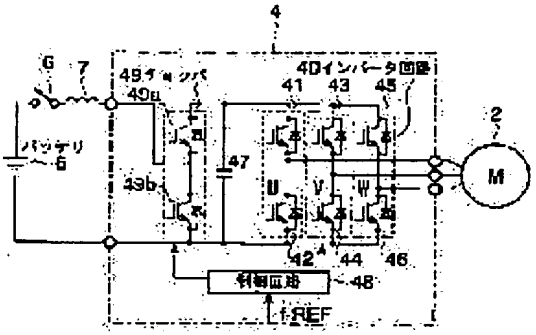
(54) INVERTER SYSTEM FOR HYBRID VEHICLE

(57)Abstract:
PROBLEM TO BE SOLVED: To improve efficiency of an inverter and to abate a noise from a three-phase alternator.
SOLUTION: An inverter system for a hybrid vehicle is equipped with the three-phase alternator 2 connected to an internal combustion engine 1, a rechargeable secondary battery 5, a step-up and step-down chopper circuit 49 which step up an output voltage of the secondary battery 5 to a desired DC voltage through a reactor 7 or step down the DC voltage to the voltage of the secondary battery 5, an inverter circuit 40 which converts an output voltage of the step-up and step-down chopper circuit 49 to AC and supplies the AC to the three-phase alternator for driving, and a control circuit 48 which controls the step-up and step-down chopper circuit 49 and the inverter circuit 40. The inverter system also control the three-phase alternator 2 with the inverter circuit 40 so that the stored energy of the secondary battery 5 assists the toque of the internal combustion engine 1 when the vehicle starts and accelerators. In this system, a control circuit 48 is equipped with a control means which stops step-up action of the step-up and step-down chopper circuit 49 when the three-phase alternator is at a predetermined speed or less and makes the inverter circuit 40 perform PWM controlling action by almost equalizing the DC voltage to the voltage of the secondary battery 5.



LEGAL STATUS

[Date of request for examination] 20.07.2005

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] The three-phase-alternating-current machine combined with internal combustion engines, such as a gasoline engine and a diesel power plant, Rechargeable batteries, such as a battery in which charge and discharge are possible, and the step-down and step-up chopper circuit which lowers the pressure of a pressure up and direct current voltage for the output voltage from said rechargeable battery to desired direct current voltage through the reactor for energy-absorbing to said rechargeable battery electrical potential difference, The inverter circuit which comes to carry out bridge connection of the semiconductor device, changes the output voltage from said step-down and step-up chopper circuit into an alternating current, supplies the alternating voltage concerned to said three-phase-alternating-current machine, and drives it, Have the control circuit which controls said step-down and step-up chopper circuit and said inverter circuit, and it is constituted. In the inverter system for hybrid cars which controlled said three-phase-alternating-current machine by said inverter circuit to carry out the torque assistance of said internal combustion engine with the accumulation-of-electricity energy of said rechargeable battery at the time of start acceleration When said three-phase-alternating-current machine is below a predetermined rate, pressure-up actuation of said step-down and step-up chopper circuit is suspended. The inverter system for hybrid cars characterized by equipping said control circuit with a means to control to make direct current voltage almost equal to said rechargeable battery electrical potential difference, and to carry out PWM control action of said inverter circuit.
[Claim 2] The three-phase-alternating-current machine combined with internal combustion engines, such as a gasoline engine and a diesel power plant, Rechargeable batteries, such as a battery in which charge and discharge are possible, and the step-down and step-up chopper circuit which lowers the pressure of a pressure up and direct current voltage for the output voltage from said rechargeable battery to desired direct current voltage through the reactor for energy-absorbing to said rechargeable battery electrical potential difference, The inverter circuit which comes to carry out bridge connection of the semiconductor device, changes the output voltage from said step-down and step-up chopper circuit into an alternating current, supplies the alternating voltage concerned to said three-phase-alternating-current machine, and drives it, Have the control circuit which controls said step-down and step-up chopper circuit and said inverter circuit, and it is constituted. In the inverter system for hybrid cars which controlled said three-phase-alternating-current machine by said inverter circuit to carry out the torque assistance of said internal combustion engine with the accumulation-of-electricity energy of said rechargeable battery at the time of start acceleration When said three-phase-alternating-current machine is operated by the idling operational status of the minimum rate, said internal combustion engine The inverter system for hybrid cars characterized by equipping said control circuit with a means to control to suspend pressure-up actuation of said step-down and step-up chopper circuit, to make direct current voltage almost equal to said rechargeable battery electrical potential difference, and to carry out PWM control action of said inverter circuit.
[Claim 3] The three-phase-alternating-current machine combined with internal combustion engines, such as a gasoline engine and a diesel power plant, Rechargeable batteries, such as a battery in which charge and discharge are possible, and the step-down and step-up chopper circuit which lowers the pressure of a pressure up and direct current voltage for the output voltage from said rechargeable battery to desired direct current voltage through the reactor for energy-absorbing to said rechargeable battery electrical potential difference, The inverter circuit which comes to carry out bridge connection of the semiconductor device, changes the output voltage from said step-down and step-up chopper circuit into an alternating current, supplies the alternating voltage concerned to said three-phase-alternating-current machine, and drives it, Have the control circuit which controls said step-down and step-up chopper circuit and said inverter circuit,

and it is constituted. In the inverter system for hybrid cars which controlled said three-phase-alternating-current machine by said inverter circuit to carry out the torque assistance of said internal combustion engine with the accumulation-of-electricity energy of said rechargeable battery at the time of start acceleration When said internal combustion engine is the idling operational status of the minimum rate, pressure-up actuation of said step-down and step-up chopper is suspended. The inverter system for hybrid cars characterized by equipping said control circuit with a means to lower the PWM control frequency of said inverter circuit to the frequency corresponding to said idling operating speed, and to control to carry out PWM actuation.

[Claim 4] The inverter system for hybrid cars characterized by making it modulate the PWM control frequency of said inverter circuit in the shape of a sine wave with a predetermined period in a predetermined frequency range in said inverter system for hybrid cars according to claim 1 or 2.

[Claim 5] The inverter system for hybrid cars characterized by making it modulate the PWM control frequency of said inverter circuit in random number in a predetermined frequency range in said inverter system for hybrid cars according to claim 1 or 2.

[Claim 6] In the inverter system for hybrid cars given in any 1 term of said claim 1 thru/or claim 5 Add a rotational frequency detection means to detect said internal combustion engine's rotational frequency, and it is based on an output signal from said rotational frequency detection means. The inverter system for hybrid cars characterized by equipping said control circuit with a means to control to stop pressure-up actuation of said step-down and step-up chopper circuit when said three-phase-alternating-current machine distinguishes that they are below a predetermined rate or idling operational status.

[Claim 7] The inverter system for hybrid cars characterized by becoming irregular so that the amplitude may be narrowed with the increment in a rate of said three-phase-alternating-current machine in said inverter system for hybrid cars according to claim 4 or 5 when modulating the PWM control frequency of said inverter circuit in a predetermined frequency range.

[Claim 8] As a three-phase-alternating-current machine combined with said internal combustion engine in the inverter system for hybrid cars given in any 1 term of said claim 1 thru/or claim 7, it is the inverter system for hybrid cars characterized by using an induction motor or a synchronous motor.

[Claim 9] The inverter system for hybrid cars characterized by equipping said control circuit with the means which it controls as said inverter circuit controls either power running, regeneration operation or excitation operation when PWM control action of said inverter circuit is carried out and electric power is supplied to said three-phase-alternating-current machine in the inverter system for hybrid cars given in any 1 term of said claim 1 thru/or claim 7.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the inverter system for hybrid cars which is applied to the inverter system used for the hybrid car which used together internal combustion engines, such as a gasoline engine and a diesel power plant, and the electric drive which made rechargeable batteries, such as a battery, the energy source, especially was made to realize the improvement in effectiveness of an inverter, and the noise reduction of a three-phase-alternating-current machine.
[0002]
[Description of the Prior Art] Recently, it has appealed for the spread of the so-called electric vehicles which drives an automobile with a three-phase-alternating-current machine by making rechargeable batteries, such as a battery, into an energy source instead of an internal combustion engine as a cure which improves the air pollution by the exhaust gas of the automobile using internal combustion engines, such as a gasoline engine and a diesel power plant, globally.
[0003] however, this electric vehicle has the short mileage in one fuel restoration, and the spread of fuel supply equipment is required for it -- etc. -- it has the problem.
[0004] So, recently, in order to solve such a problem, the hybrid car which used the electric drive together has attracted attention.
[0005] A mechanical component links a three-phase-alternating-current machine with an internal combustion engine directly, and is constituted, and he is trying to drive a wheel through transmission in the hybrid car which used together this kind of electric drive.
[0006] Moreover, a three-phase-alternating-current machine is controlled by the inverter, and he performs torque assistance, energy regeneration, an internal combustion engine's starting, and electric braking, and is trying to use a rechargeable battery as a power source and an energy source.
[0007] That is, at the time of start acceleration, a three-phase-alternating-current machine is controlled by the inverter, and exhaust gas reduction of an internal combustion engine is performed so that the torque assistance of the internal combustion engine may be carried out with the accumulation-of-electricity energy of a rechargeable battery.
[0008] Moreover, at the time of halt braking, regeneration operation of the three-phase-alternating-current machine is carried out by control of an inverter, and the inertia energy of a car is stored electricity at a rechargeable battery.
[0009] Thereby, energy balance is maintained with energy saving and it is made to realize low-pollution-izing and a fuel consumption improvement of exhaust gas.
[0010] Drawing 8 is the schematic diagram showing the fundamental example of a configuration of the mechanical component of this kind of hybrid car.
[0011] The mechanical component of a hybrid car is constituted by the internal combustion engines 1, such as a gasoline engine and a diesel power plant, and the three-phase-alternating-current machine 2 linking directly to this internal combustion engine 1, and he is trying to drive a wheel through transmission 3 in drawing 8 .
[0012] Moreover, the three-phase-alternating-current machine 2 is controlled by the inverter 4, performs torque assistance, energy regeneration, an internal combustion engine's 1 starting, and electric braking, and is using the rechargeable batteries 5, such as a battery, as a power source and an energy source.
[0013] Drawing 9 is the circuit diagram showing the conventional example of the inverter structure of a system used for this kind of hybrid car, and attaches and shows the same sign to the same element as drawing 8 .

[0014] In drawing 9 , the inverter system for hybrid cars changes into an alternating current the output voltage of the three-phase-alternating-current machine 2 combined with the above-mentioned internal combustion engine 1, the rechargeable batteries 5, such as a battery in which charge and discharge are possible, and this rechargeable battery 5 through a switch 6, and consists of inverters 4 which supply this alternating voltage to the three-phase-alternating-current machine 2, and drive it.
[0015] Moreover, the inverter 4 consists of the inverter circuit 40 which carried out bridge connection of two or more semiconductor devices 41-46, a direct-current capacitor 47 for smooth, and a control circuit 48 which controls an inverter circuit 40.
[0016] And the three-phase-alternating-current machine 2 is controlled by the inverter circuit 40 to carry out the torque assistance of the internal combustion engine 1 with the accumulation-of-electricity energy of a rechargeable battery 5 at the time of start acceleration of a hybrid car.
[0017] By the way, in such an inverter system for hybrid cars, there are needs of a capacity rise of a system and improvement in the drive power of the three-phase-alternating-current machine 2 and improvement in regeneration power are needed in recent years.
[0018] In order that the conventional three-phase-alternating-current machine 2 may not increase a current since a current increases with capacity increase and the appearance of the three-phase-alternating-current machine 2 becomes large, although rated voltage is the three-phase-alternating-current machine of AC200V system, but it may raise capacity, the approach of making an electrical potential difference AC400V system is adopted.
[0019] Although carrying out PWM control action of the inverter, and performing current control of the three-phase-alternating-current machine 2 generally is performed, in order to output AC400V, it is necessary to make direct current voltage into about 600V.
[0020] However, in order to obtain the direct current voltage of 600V with a rechargeable battery 5, it is necessary to connect 12V dc-battery to an about 50-piece serial, and the tooth space and weight in the case of carrying in a car pose a problem.
[0021] Then, the approach proposed recently is an approach of preparing a pressure-up chopper circuit which is indicated by "JP,6-245332,A."
[0022] The direct current voltage of hope can be obtained by this approach, without increasing the number of rechargeable battery 5 electrical potential difference, i.e., a dc-battery.
[0023] And in order to take the drive power of the three-phase-alternating-current machine 2, and large regeneration power, the method of preparing the step-down and step-up chopper circuit which specifically has the function which carries out the pressure up of the rechargeable battery 5 electrical potential difference, and the function which lowers the pressure of direct current voltage on rechargeable battery 5 electrical potential difference is effective.
[0024]
[Problem(s) to be Solved by the Invention] However, although the purpose of improvement in the drive power of the three-phase-alternating-current machine 2 and improvement in regeneration power can be attained by preparing a step-down and step-up chopper circuit Also in the time of the internal combustion engine's 1 minimum standby operational status, i.e., an idling condition Since the pressure-up chopper of a step-down and step-up chopper circuit is operated, loss of the semiconductor device of a step-down and step-up chopper circuit is large, and when direct current voltage is high, the switching loss of an inverter circuit 40 will also be large, and decline in the effectiveness of the whole inverter will be caused.
[0025] moreover, the case where PWM control action is carried out on a low electrical potential difference when PWM control action of the inverter circuit 40 was carried out on the high electrical potential difference -- a ratio -- BE ** and three-phase-alternating-current machine 2 loss also become large.
[0026] Furthermore, the problem that the magnetic noise of the three-phase-alternating-current machine 2 equivalent to the PWM control frequency of an inverter circuit 40 becomes large, and the engine sound of a car and a heterogeneous magnetic sound become jarring occurs.
[0027] The purpose of this invention is to offer the inverter system for hybrid cars of the high-reliability which can plan the improvement in effectiveness of an inverter, and the noise reduction of a three-phase-alternating-current machine.
[0028]
[Means for Solving the Problem] The three-phase-alternating-current machine combined with internal combustion engines, such as a gasoline engine and a diesel power plant, in order to attain the above-mentioned purpose, Rechargeable batteries, such as a battery in which charge and discharge are possible, and the step-down and step-up chopper circuit which lowers the pressure of a pressure up and direct current

voltage for the output voltage from the rechargeable battery concerned to desired direct current voltage through the reactor for energy-absorbing to a rechargeable battery electrical potential difference, The inverter circuit which comes to carry out bridge connection of the semiconductor device, changes the output voltage from a step-down and step-up chopper circuit into an alternating current, supplies the alternating voltage concerned to a three-phase-alternating-current machine, and drives it, Have the control circuit which controls a step-down and step-up chopper circuit and a circuit, and it is constituted. In the inverter system for hybrid cars which controlled the 3 inverter phase AC machine by the inverter circuit to carry out the torque assistance of the internal combustion engine with the accumulation-of-electricity energy of a rechargeable battery at the time of start acceleration In invention corresponding to claim 1, when a three-phase-alternating-current machine is below a predetermined rate, the control circuit is equipped with a means to control to suspend pressure-up actuation of a step-down and step-up chopper circuit, to make direct current voltage almost equal to a rechargeable battery electrical potential difference, and to carry out PWM control action of the inverter circuit.

[0029] Therefore, it sets to the inverter system for hybrid cars of invention corresponding to claim 1. By suspending pressure-up actuation of a step-down and step-up chopper circuit, namely, stopping chopping actuation, and making it flow only through the semiconductor device of an upper arm continuously, when a three-phase-alternating-current machine is below a predetermined rate While loss of an inverter can be reduced and effectiveness can be improved by making direct current voltage almost equal to a rechargeable battery electrical potential difference, carrying out PWMM control action of the inverter circuit, and supplying electric power to a three-phase-alternating-current machine, the noise (magnetic sound) of a three-phase-alternating-current machine can also be reduced.

[0030] Moreover, the control circuit is equipped with a means to control by invention corresponding to claim 2 so that an internal combustion engine suspends pressure-up actuation of a step-down and step-up chopper circuit, makes direct current voltage almost equal to a rechargeable battery electrical potential difference and does PWM control action of the inverter circuit, when the three-phase-alternating-current machine is operated by the idling operational status of the minimum rate.

[0031] Therefore, it sets to the inverter system for hybrid cars of invention corresponding to claim 2. When the three-phase-alternating-current machine is operated by the idling operational status of the minimum rate, an internal combustion engine By suspending pressure-up actuation of a step-down and step-up chopper circuit, making direct current voltage almost equal to a rechargeable battery electrical potential difference, carrying out PWM control action of the inverter circuit, and supplying electric power to a three-phase-alternating-current machine While loss of the inverter at the time of the idling condition which a car is stopping can be reduced and effectiveness can be improved, the RF MAG sound of an inverter proper can also be reduced.

[0032] Furthermore, in invention corresponding to claim 3, when an internal combustion engine is the idling operational status of the minimum rate, pressure-up actuation of a step-down and step-up chopper was suspended, and the control circuit is equipped with a means to lower the PWM control frequency of an inverter circuit to the frequency corresponding to an idling operating speed, and to control to carry out PWM actuation.

[0033] Therefore, in the inverter system for hybrid cars of invention corresponding to claim 3, when an internal combustion engine is the idling operational status of the minimum rate, pressure-up actuation of a step-down and step-up chopper can be suspended, the PWM control frequency of an inverter circuit is lowered to the frequency corresponding to an idling operating speed, by carrying out PWM actuation and supplying electric power to a three-phase-alternating-current machine, loss of the inverter in the rate below idling operational status can be reduced, and effectiveness can be improved.

[0034] He is trying to, modulate the PWM control frequency of an inverter circuit in the shape of a sine wave with a predetermined period by invention corresponding to claim 4 on the other hand in a predetermined frequency range in the inverter system for hybrid cars of invention corresponding to above-mentioned claim 1 or claim 2.

[0035] therefore, in the inverter system for hybrid cars of invention corresponding to claim 4, a switching frequency is changed by modulating the PWM control frequency of an inverter circuit in the shape of a sine wave with a period predetermined in a predetermined frequency range, and supplying electric power to a three-phase-alternating-current machine -- making -- the electromagnetism of a three-phase-alternating-current machine -- the noise can be reduced.

[0036] Moreover, he is trying to modulate the PWM control frequency of an inverter circuit in random number in invention corresponding to claim 5 in a predetermined frequency range in the inverter system for

hybrid cars of invention corresponding to above-mentioned claim 1 or claim 2.
[0037] therefore, the thing for which the PWM control frequency of an inverter circuit is modulated in random number in a predetermined frequency range, and electric power is supplied to a three-phase-alternating-current machine in the inverter system for hybrid cars of invention corresponding to claim 5 -- the electromagnetism of a three-phase-alternating-current machine -- the noise can be reduced. in this case, the rate of change [case / where it changes a fixed period like invention corresponding to above-mentioned claim 4 by considering especially as a random number] of switching -- large -- becoming -- more -- much more -- the electromagnetism of a three-phase-alternating-current machine -- the noise can be reduced.
[0038] Furthermore, in invention corresponding to claim 6, it sets to the inverter system for hybrid cars of invention corresponding to any 1 term of above-mentioned claim 1 thru/or claim 5. Add a rotational frequency detection means to detect an internal combustion engine's rotational frequency, and it is based on an output signal from a rotational frequency detection means. The control circuit is equipped with a means to control to stop pressure-up actuation of a step-down and step-up chopper circuit when a three-phase-alternating-current machine distinguishes that they are below a predetermined rate or idling operational status.
[0039] Therefore, in the inverter system for hybrid cars of invention corresponding to claim 6, when an internal combustion engine's rotational frequency is detected and it is distinguished based on the rotational frequency concerned that a three-phase-alternating-current machine is below a predetermined rate or idling operational status, high matching of precision with an internal combustion engine can be performed by stopping pressure-up actuation of a step-down and step-up chopper circuit.
[0040] On the other hand, in invention corresponding to claim 7, in the inverter system for hybrid cars of invention corresponding to above-mentioned claim 4 or claim 5, when modulating the PWM control frequency of an inverter circuit in a predetermined frequency range, it becomes irregular so that the amplitude may be narrowed with the increment in a rate of a three-phase-alternating-current machine.
[0041] Therefore, in the inverter system for hybrid cars of invention corresponding to claim 7, when modulating the PWM control frequency of an inverter circuit with a predetermined period in a predetermined frequency range, by becoming irregular so that the amplitude may be narrowed with the increment in a rate of a three-phase-alternating-current machine, the switching frequency in a high-speed rotation region can be made high, and the stability of control can be raised. In this case, in a high-speed rotation region, since an internal combustion engine sound is also loud and the noise of a three-phase-alternating-current machine becomes small, even if it makes the range of fluctuation of a switching frequency small, there is especially no problem.
[0042] Moreover, in invention corresponding to claim 8, the induction motor or the synchronous motor is used in the inverter system for hybrid cars of invention corresponding to any 1 term of above-mentioned claim 1 thru/or claim 7 as a three-phase-alternating-current machine combined with an internal combustion engine.
[0043] Therefore, as a three-phase-alternating-current machine combined with an internal combustion engine, by using an induction motor or a synchronous motor, it can respond to both at the time of using an induction motor or a synchronous motor for a three-phase-alternating-current machine smoothly, and the same operation as the above-mentioned case can be done so in the inverter system for hybrid cars of invention corresponding to claim 8.
[0044] Furthermore, in invention corresponding to claim 9, in the inverter system for hybrid cars of invention corresponding to any 1 term of above-mentioned claim 1 thru/or claim 7, when carrying out PWM control action of the inverter circuit and supplying electric power to a three-phase-alternating-current machine, the inverter circuit equips said control circuit with a means to control to control either power running, regeneration operation or excitation operation.
[0045] Therefore, it sets to the inverter system for hybrid cars of invention corresponding to claim 9. When carrying out PWM control action of the inverter circuit and supplying electric power to a three-phase-alternating-current machine, an inverter circuit by being made to control either power running, regeneration operation or excitation operation Since an inverter circuit serves as operation mode of power running, regeneration operation or excitation operation either and can improve system-wide performance, it can raise system-wide effectiveness further as a result.
[0046] By the above, it becomes possible to plan the improvement in effectiveness of an inverter, and the noise reduction of a three-phase-alternating-current machine, and the highly reliable inverter system for hybrid cars can be obtained.
[0047]

[Embodiment of the Invention] This invention suspends pressure-up actuation of a step-down and step-up chopper circuit, when a three-phase-alternating-current machine is below a predetermined rate. [whether it controls to make direct current voltage almost equal to a rechargeable battery electrical potential difference, and to carry out PWM control action of the inverter circuit, and] Or when the three-phase-alternating-current machine is operated by the idling operational status of the minimum rate, an internal combustion engine or [controlling to suspend pressure-up actuation of a step-down and step-up chopper circuit, to make direct current voltage almost equal to a rechargeable battery electrical potential difference, and to carry out PWM control action of the inverter circuit] -- or When an internal combustion engine is the idling operational status of the minimum rate, pressure-up actuation of a step-down and step-up chopper is suspended. By lowering the PWM control frequency of an inverter circuit to the frequency corresponding to an idling operating speed, and controlling to carry out PWM actuation, it is going to plan the improvement in effectiveness of an inverter, and the noise reduction of a three-phase-alternating-current machine.
[0048] Hereafter, the gestalt of operation of this invention based on the above views is explained to a detail with reference to a drawing.
[0049] (Gestalt of the 1st operation) Drawing 1 is the circuit diagram showing the example for hybrid cars of the inverter structure of a system by the gestalt of this operation, and attaches and shows the same sign to the same element as drawing 9 .
[0050] In drawing 1 the inverter system for hybrid cars of the gestalt of this operation The three-phase-alternating-current machine 2 combined with the internal combustion engines 1, such as a gasoline engine and a diesel power plant, A switch 6 and the step-down-and-step-up reactor 7 for energy-absorbing are minded for the output voltage from the rechargeable batteries 5, such as a battery in which charge and discharge are possible, and this rechargeable battery 5. To desired direct current voltage A pressure up, Moreover, the step-down and step-up chopper circuit 49 which lowers the pressure of direct current voltage to rechargeable battery 5 electrical potential difference, The direct-current capacitor 47 which carries out smooth [of the output voltage from the step-down and step-up chopper circuit 49], The electrical potential difference by which smooth was carried out with the direct-current capacitor 47 is changed into an alternating current, and it constitutes from an inverter circuit 40 which supplies this alternating voltage to the three-phase-alternating-current machine 2, and drives it, and a control circuit 48 which controls the step-down and step-up chopper circuit 49 and an inverter circuit 40.
[0051] In addition, the inverter 4 consists of the inverter circuit 40, a direct-current capacitor 47, a control circuit 48, and a step-down and step-up chopper circuit 49.
[0052] Here, the step-down and step-up chopper circuit 49 has come to carry out series connection of two or more semiconductor devices 49a and 49b of a top and the bottom.
[0053] Moreover, the inverter circuit 40 has come to carry out bridge connection of two or more semiconductor devices 41-46.
[0054] Furthermore, a control circuit 48 so that the torque assistance of the internal combustion engine 1 may be carried out with the accumulation-of-electricity energy of a rechargeable battery 5 at the time of start acceleration of a hybrid car The function controlled to control the three-phase-alternating-current machine 2 by the inverter circuit 40, By suspending pressure-up actuation of the step-down and step-up chopper circuit 49, namely, stopping chopping actuation, and making it flow only through the semiconductor device of an upper arm continuously, when the three-phase-alternating-current machine 2 is below a predetermined rate It has the function controlled to make direct current voltage almost equal to rechargeable battery 5 electrical potential difference, and to carry out PWM control action of the inverter circuit 40.
[0055] Next, an operation of the inverter system for hybrid cars by the gestalt of this operation constituted as mentioned above is explained using the timing diagram Fig. shown in drawing 2 .
[0056] Now, if a starting command is inputted in the time of day to of drawing 2 , a switch 6 is turned on, each semiconductor device 41 of an inverter circuit 40 - 46 HEGETO signals are outputted from a control circuit 48 according to a rate reference signal, an inverter 4 will be a predetermined output frequency (f-INV), and the three-phase-alternating-current machine 2 which is a load will be driven.
[0057] In this phase, the step-down and step-up chopper circuit 49 turns on only upper semiconductor device 49a, and supplies power to the three-phase-alternating-current machine 2 which is a load from a rechargeable battery 5.
[0058] Therefore, as direct current voltage, an electrical potential difference almost equal to rechargeable battery 5 electrical potential difference is supplied to an inverter circuit 40.
[0059] Next, in the time of day t1 of drawing 2 , when the magnitude of a rate reference signal becomes more than predetermined level (L1 of drawing 2), an inverter circuit 40 is controlled to carry out switching

operation of the semiconductor devices 49a and 49b of the step-down and step-up chopper circuit 49 top and the bottom, and to carry out the pressure up of the direct current voltage.
[0060] For example, if rated voltage of the three-phase-alternating-current machine 2 is set to AC400V, it is necessary to carry out PWM control about direct-current-voltage 600V but, and even when rechargeable battery 5 electrical potential difference is 300V, it can output to about 50% of AC200V, without carrying out a pressure up.
[0061] Therefore, since it is not necessary to operate the step-down and step-up chopper circuit 49 to about 50% of rate, loss of an inverter 4 can be reduced.
[0062] Furthermore, since the peak value of an PWM voltage waveform becomes 50%, the magnetic sound of the three-phase-alternating-current machine 2 can also be reduced.
[0063] As mentioned above, while loss of an inverter 4 can be reduced and effectiveness can be improved since pressure-up chopper actuation of the step-down and step-up chopper circuit 49 is suspended when the three-phase-alternating-current machine 2 is below a predetermined rate, in the inverter system for hybrid cars by the gestalt of this operation, it becomes possible to also reduce the noise (magnetic sound) of the three-phase-alternating-current machine 2.
[0064] (Gestalt of the 2nd operation) The circuitry of the inverter system for hybrid cars of the gestalt of this operation is the same as that of said drawing 1 , and a part of functions which a control circuit 48 has differ.
[0065] Namely, when the three-phase-alternating-current machine 2 mentioned above is below a predetermined rate, a control circuit 48 Instead of the function controlled to suspend pressure-up actuation of the step-down and step-up chopper circuit 49, to make direct current voltage almost equal to rechargeable battery 5 electrical potential difference, and to carry out PWM control action of the inverter circuit 40 When the three-phase-alternating-current machine 2 is operated by the idling operational status of the minimum rate, an internal combustion engine 1 By suspending pressure-up actuation of the step-down and step-up chopper circuit 49, namely, stopping chopping actuation, and making it flow only through the semiconductor device of an upper arm continuously It shall have the function controlled to make direct current voltage almost equal to rechargeable battery 5 electrical potential difference, and to carry out PWM control action of the inverter circuit 40.
[0066] Next, an operation of the inverter system for hybrid cars by the gestalt of this operation constituted as mentioned above is explained using the timing diagram Fig. shown in drawing 3 .
[0067] In addition, the explanation is omitted about an operation of the gestalt of said 1st operation, and an operation of the same part, and only an operation of a part different here is described.
[0068] That is, as shown in drawing 3 , loss of the inverter 4 at the time of the idling condition which a car is stopping can be reduced by controlling so that the internal combustion engine 1 suspends pressure-up chopper actuation in between only at the time of the condition of the minimum rate, and an internal combustion engine's 1 idling operational status.
[0069] Furthermore, the RF MAG sound of inverter 4 proper which carries out PWM control action can also be reduced.
[0070] As mentioned above, while the internal combustion engine 1 can reduce loss of the inverter 4 at the time of the idling condition which a car is stopping and can improve effectiveness since he is suspending pressure up chopper actuation of the step-down and step-up chopper circuit 49 when the three-phase alternating current machine 2 is operated by the idling operational status of the minimum rate, in the inverter system for hybrid cars by the gestalt of this operation, it becomes possible to also reduce the RF MAG sound of inverter 4 proper.
[0071] (Gestalt of the 3rd operation) The circuitry of the inverter system for hybrid cars of the gestalt of this operation is the same as that of said drawing 1 , and a part of functions which a control circuit 48 has differ.
[0072] Namely, when the three-phase-alternating-current machine 2 mentioned above is below a predetermined rate, a control circuit 48 Instead of the function controlled to suspend pressure-up actuation of the step-down and step-up chopper circuit 49, to make direct current voltage almost equal to rechargeable battery 5 electrical potential difference, and to carry out PWM control action of the inverter circuit 40 When an internal combustion engine is the idling operational status of the minimum rate, pressure-up actuation of a step-down and step-up chopper shall be suspended, and it shall have the function which lowers the PWM control frequency of an inverter circuit to the frequency corresponding to an idling operating speed, and is controlled to carry out PWM actuation.
[0073] Next, an operation of the inverter system for hybrid cars by the gestalt of this operation constituted as mentioned above is explained using the timing diagram Fig. shown in drawing 4 .
[0074] In addition, the explanation is omitted about an operation of the gestalt of said 1st operation, and an

operation of the same part, and only an operation of a part different here is described.
[0075] That is, as shown in drawing 4 , when the switching frequency (p-INV) of an inverter 4 is lowered to constant frequency at the rate of below idle operational status and it becomes a rate beyond idle operational status, by controlling to make a switching frequency increase, loss of the inverter 4 in the rate below idling operational status can be reduced, and effectiveness can be improved.
[0076] Since pressure-up actuation of the step-down and step-up chopper of the step-down and step-up chopper circuit 49 is suspended, the PWM control frequency of an inverter circuit 40 is lowered to the frequency corresponding to an idling operating speed and it is made to carry out PWM actuation in the inverter system for hybrid cars by the gestalt of this operation when an internal combustion engine 1 is the idling operational status of the minimum rate as mentioned above, it becomes possible to reduce loss of the inverter 4 in the rate below idling operational status, and to improve effectiveness.
[0077] (Gestalt of the 4th operation) The circuitry of the inverter system for hybrid cars of the gestalt of this operation is the same as that of said drawing 1 , and a part of functions which a control circuit 48 has differ.
[0078] That is, in addition to the function of the gestalt of said 1st operation, the control circuit 48 shall have the function to modulate the PWM control frequency of an inverter circuit 40 in the shape of a sine wave with a predetermined period in a predetermined frequency range.
[0079] Next, an operation of the inverter system for hybrid cars by the gestalt of this operation constituted as mentioned above is explained using the timing diagram Fig. shown in drawing 5 .
[0080] In addition, the explanation is omitted about an operation of the gestalt of said 1st operation, and an operation of the same part, and only an operation of a part different here is described.
[0081] that is, as shown in drawing 5 , a switching frequency is changed by carrying out adjustable [of the switching frequency (p-INV) of an inverter 4] by the sine wave of a certain fixed period -- making -- the electromagnetism of the three-phase-alternating-current machine 2 -- the noise can be reduced.
[0082] as mentioned above, since he is trying to modulate the PWM control frequency of an inverter circuit 40 in the shape of a sine wave with a period predetermined in a predetermined frequency range, a switching frequency is changed in the inverter system for hybrid cars by the gestalt of this operation -- making -- the electromagnetism of the three-phase-alternating-current machine 2 -- it becomes possible to reduce the noise.
[0083] (Gestalt of the 5th operation) The circuitry of the inverter system for hybrid cars of the gestalt of this operation is the same as that of said drawing 1 , and a part of functions which a control circuit 48 has differ.
[0084] That is, in addition to the function of the gestalt of said 1st operation, the control circuit 48 shall have the function to modulate the PWM control frequency of an inverter circuit 40 in random number in a predetermined frequency range.
[0085] Next, an operation of the inverter system for hybrid cars by the gestalt of this operation constituted as mentioned above is explained using the timing diagram Fig. shown in drawing 6 .
[0086] In addition, the explanation is omitted about an operation of the gestalt of said 1st operation, and an operation of the same part, and only an operation of a part different here is described.
[0087] namely, the thing done for adjustable [of the switching frequency (p-INV) of an inverter 4] with a random number as shown in drawing 6 (without it gives regularity) -- the electromagnetism of the three-phase-alternating-current machine 2 -- the noise can be reduced.
[0088] in this case, the rate of change [case / where it changes a fixed period like the gestalt of said 4th operation by considering especially as a random number] of switching -- large -- becoming -- more -- much more -- the electromagnetism of the three-phase-alternating-current machine 2 -- the noise can be reduced.
[0089] as mentioned above, since he is trying to modulate the PWM control frequency of an inverter circuit 40 in random number in a predetermined frequency range, a switching frequency is changed in the inverter system for hybrid cars by the gestalt of this operation -- making -- the electromagnetism of the three-phase-alternating-current machine 2 -- it becomes possible to reduce the noise further.
[0090] (Gestalt of the 6th operation) The circuitry of the inverter system for hybrid cars of the gestalt of this operation In said the 1st thru/or inverter system for hybrid cars of the gestalt of the 5th one of operations, the rotational frequency detector which detects an internal combustion engine's 1 rotational frequency is added. Further a control circuit 48 In addition to said function of the gestalt of operation of either [the 1st thru/or / 5th / either] it is based on an output signal from a rotational frequency detector. When the three-phase-alternating-current machine 2 distinguishes that they are below a predetermined rate or idling operational status, it shall have the function controlled to stop pressure-up actuation of the step-down and step-up chopper circuit 49.
[0091] Next, an operation of the inverter system for hybrid cars by the gestalt of this operation constituted as

mentioned above is explained.
[0092] In addition, the explanation is omitted about an operation of the gestalt of said 1st operation, and an operation of the same part, and only an operation of a part different here is described.
[0093] That is, high matching of precision with an internal combustion engine 1 can be performed by incorporating the output signal from the detector which detects an internal combustion engine's 1 rotational frequency to a control circuit 48, distinguishing that the three-phase-alternating-current machine 2 is in below a predetermined rate or idling operational status, and controlling to suspend pressure-up actuation of the step-down and step-up chopper circuit 49.
[0094] As mentioned above, since he is trying to stop pressure-up actuation of the step-down and step-up chopper circuit 49 when an internal combustion engine's 1 rotational frequency is detected and it is distinguished based on this rotational frequency that the three-phase-alternating-current machine 2 is below a predetermined rate or idling operational status, in the inverter system for hybrid cars by the gestalt of this operation, it becomes possible to perform high matching of precision with an internal combustion engine 1.
[0095] (Gestalt of the 7th operation) The circuitry of the inverter system for hybrid cars of the gestalt of this operation is the same as that of said drawing 1 , and a part of functions which a control circuit 48 has differ.
[0096] That is, the control circuit 48 shall have the function modulated so that the amplitude may be narrowed with the increment in a rate of the three-phase-alternating-current machine 2, when modulating the PWM control frequency of an inverter circuit 40 with a predetermined period in a predetermined frequency range in addition to the function of the gestalt of said 4th operation.
[0097] Next, an operation of the inverter system for hybrid cars by the gestalt of this operation constituted as mentioned above is explained using the timing diagram shown in drawing 7 .
[0098] In addition, the explanation is omitted about an operation of the gestalt of said 4th operation, and an operation of the same part, and only an operation of a part different here is described.
[0099] That is, by narrowing width of face of the amplitude (PH-PL) of a switching frequency, the switching frequency in a high-speed rotation region can be made high, and the stability of control can be raised as are shown in drawing 7 and an internal combustion engine's 1 engine speed becomes high.
[0100] In this case, in a high-speed rotation region, since an internal combustion engine first sound is also loud and the noise of the three-phase-alternating-current machine 2 becomes small, even if it makes the range of fluctuation of a switching frequency small, there is especially no problem.
[0101] In the inverter system for hybrid cars by the gestalt of this operation, as mentioned above, since it is made to narrow the amplitude with the increment in a rate of the three-phase-alternating-current machine 2 when modulating the PWM control frequency of an inverter circuit 40 with a period predetermined in a predetermined frequency range, the switching frequency in the high-speed rotation region to modulate is made high, and it becomes possible to raise the stability of control.
[0102] (Gestalt of the 8th operation) The circuitry of the inverter system for hybrid cars of the gestalt of this operation is the same as that of said drawing 1 , and he is trying to use an induction motor or a synchronous motor as a three-phase-alternating-current machine 2 combined with said internal combustion engine 1.
[0103] Next, in the inverter system for hybrid cars by the gestalt of this operation constituted as mentioned above, the same operation as the case of the gestalt of each operation mentioned above can be done so by using the induction motor or the synchronous motor corresponding to both at the time of using an induction motor or a synchronous motor for the three-phase-alternating-current machine 2 as a three-phase-alternating-current machine 2 combined with an internal combustion engine 1.
[0104] In the inverter system for hybrid cars by the gestalt of this operation, as mentioned above, since he is trying to use an induction motor or a synchronous motor, it corresponds to both at the time of using an induction motor or a synchronous motor for the three-phase-alternating-current machine 2 smoothly, and it becomes possible to do the above-mentioned effectiveness so as a three-phase-alternating-current machine 2 combined with an internal combustion engine 1.
[0105] (Gestalt of the 9th operation) The circuitry of the inverter system for hybrid cars of the gestalt of this operation is the same as that of said drawing 1 , and a part of functions which a control circuit 48 has differ.
[0106] That is, the control circuit 48 shall have the function which it controls as an inverter circuit 40 controls either power running, regeneration operation or excitation operation, when in addition to the function of the gestalt of said 1st operation carrying out PWM control action of the inverter circuit 40 and supplying electric power to the three-phase-alternating-current machine 2.
[0107] Next, it sets to the inverter system for hybrid cars by the gestalt of this operation constituted as mentioned above. When carrying out PWM control action of the inverter circuit 40 and supplying electric power to the three-phase-alternating-current machine 2, an inverter circuit 40 By being made to control

either power running, regeneration operation or excitation operation, an inverter circuit 40 It can become the operation mode of power running, regeneration operation or excitation operation either, torque assistance can be carried out in power-running mode, it can charge in regeneration operation mode, and a response (response) can be received by preliminary excitation in excitation operation mode.
[0108] Thereby, since system-wide performance can be improved, system-wide effectiveness can be further raised as a result.
[0109] As mentioned above, in the inverter system for hybrid cars by the gestalt of this operation When carrying out PWM control action of the inverter circuit 40 and supplying electric power to the three-phase-alternating-current machine 2, an inverter circuit 40 Since it is made to control either power running, regeneration operation or excitation operation, an inverter circuit 40 Since it becomes the operation mode of power running, regeneration operation or excitation operation either and system-wide performance can be improved, it becomes possible to raise system-wide effectiveness further as a result.
[0110]
[Effect of the Invention] As explained above, according to the inverter system for hybrid cars of this invention When a three-phase-alternating-current machine is below a predetermined rate, pressure-up actuation of a step-down and step-up chopper circuit is suspended. [whether it controls to make direct current voltage almost equal to a rechargeable battery electrical potential difference, and to carry out PWM control action of the inverter circuit, and] Or when the three-phase-alternating-current machine is operated by the idling operational status of the minimum rate, an internal combustion engine [whether it controls to suspend pressure-up actuation of a step-down and step-up chopper circuit, to make direct current voltage almost equal to a rechargeable battery electrical potential difference, and to carry out PWM control action of the inverter circuit, and] Or when an internal combustion engine is the idling operational status of the minimum rate, pressure-up actuation of a step-down and step-up chopper is suspended. Since the PWM control frequency of an inverter circuit is lowered to the frequency corresponding to an idling operating speed and he is trying to control to carry out PWM actuation, it becomes possible to plan the improvement in effectiveness of an inverter, and the noise reduction of a three-phase-alternating-current machine.

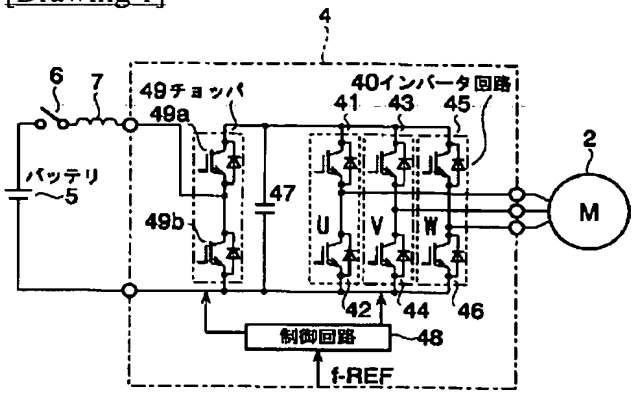
[Translation done.]

* NOTICES *

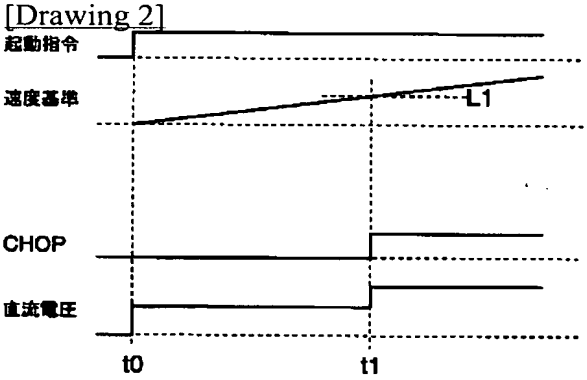
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

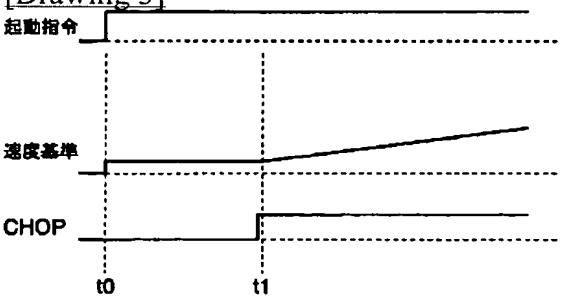
[Drawing 1]



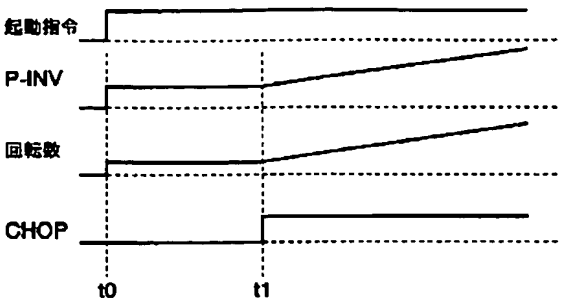
[Drawing 2]



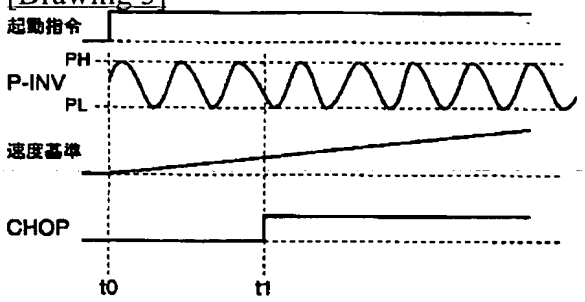
[Drawing 3]



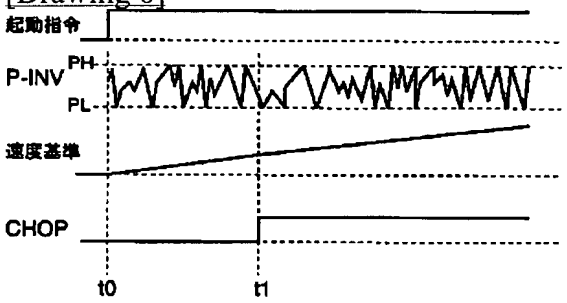
[Drawing 4]



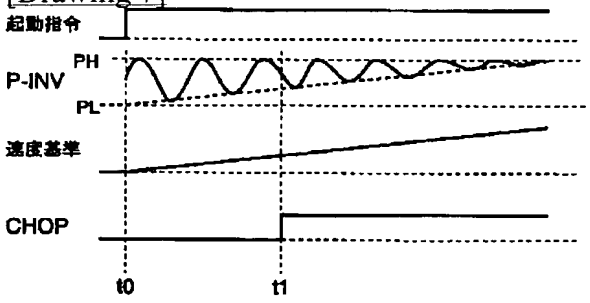
[Drawing 5]



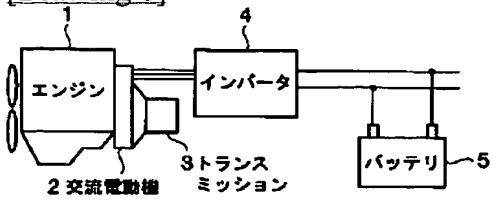
[Drawing 6]



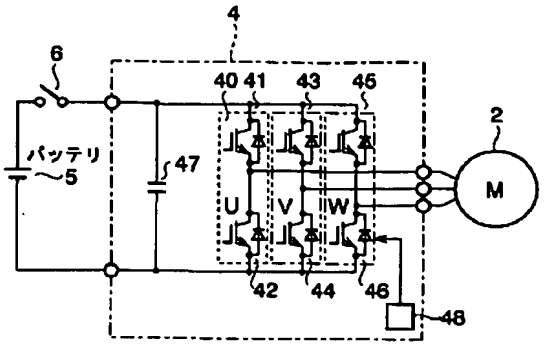
[Drawing 7]



[Drawing 8]



[Drawing 9]



[Translation done.]